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Master Project for Rilind Ballazhi, Radhika Garg, Serge Hänni, and Sutharshini Rasathurai

Task Description: Martin Waldburger, Prof. Dr. Burkhard Stiller

Title: **Client-, Server-, and Model-driven Extensions of a Decision Support System for International Service Contracting**

Start Date: June 20, 2011

End Date: September 20, 2011

Supervisor: Martin Waldburger, Prof. Dr. Burkhard Stiller

Location: Room 1.D.17, Home

Support: Private International Law, Electronic Service Contracts, Service Level Management

1. Introduction and Motivation

The Internet has become a critical infrastructure in an international service economy as it determines one of the few infrastructures with (near-)global outreach. The Internet represents today a vast market for content, services, and applications. Commercially offered electronic services in the Internet ask for the respective electronic service contracts to be concluded prior to service usage. Electronic service contracts in the Internet are likely to show international connection, *i.e.*, service provider and service customer may have relations into different legal domains (*e.g.*, states) and/or the respective contracted service may have to be provided internationally.

Private International Law (PIL) lays out the legal frame to be consistent with for two key parameters in electronic service contracts with international connection: Jurisdiction and applicable law. These two contract parameters are both in relation to disputes that may arise out of a concluded contract. Jurisdiction says which state's courts are authorized to hear and decide in a contractual dispute, and applicable law says under which state's law such decision



shall be found. Both contract parameters have important implications for service providers and service customers alike, since they potentially dictate a court trial in a foreign state and/or under foreign law. And since electronic service contracts in the Internet are likely to show international connection, both contract parameters are of special importance for commercial service offerings in the Internet.

Consequently, a decision support system for international electronic service contracting has been developed. The system hooks into the contract formation process. It receives input from a service provider and a service customer. This input embraces a basic set of so-called connecting factors. PIL works based on connecting factors (e.g., state in which a contract party has domicile) in order to attribute jurisdiction and applicable law. Accordingly, the system produces recommendations for suitable jurisdictions and applicable laws based on a reasoning process that reflects the underlying PIL.

Although the decision support system applies a straight-forward input-reasoning-output scheme, it is highly complex due to a number of reasons. First, there is no common, internationally harmonized PIL. Typically, each state has its own PIL, plus there are bi- and multilateral PIL conventions. As the legal basis is highly diverse, the respective needed input for the decision support system (*i.e.*, the connecting factors) are diverse as well. Relevant connecting factors may differ from PIL to PIL. The same holds true for the actual reasoning process. Each PIL governs its own reasoning based on which jurisdiction and applicable law is attributed. Furthermore, a different set of connecting factors and a different reasoning may imply incompatible outcomes. Consequently, the decision support system relies on a developed methodology that models different PILs for machine execution and implementation in the decision support tool.

The implementation of the decision support system and the PIL modeling method have both been shown to produce meaningful results, in principle. Nonetheless, both the decision support system and the base of already modeled PILs are at this point limited. Both should be extended. The decision support system should become accessible for everyone. This requires client- and server-side extensions to be developed. And the modeling and implementation of covered PILs is currently focused on a partial European perspective. The geographical scope of modeled and implemented PILs should go beyond this narrow scope of today. Accordingly, this Master Project is motivated by a number of important client-, server-, and model-driven extensions of the existing decision support system for International service contracting as described in further detail subsequently.

2. Description of Work

This Master Project endorses three areas of work and the respective three main contributions to be made. The first includes the modeling and implementation of a wider legal basis for the existing decision support system. The second includes the server-side handling of queries and answers (here in terms of jurisdiction/applicable law recommendations) that base on the existing decision support system. And the third includes the client-side web application for a service provider and a service customer.

These three areas of work may be addressed separately, *e.g.*, by a student each, but they show inter-dependencies which shall not be ignored. The range of modeled and implemented PILs determines the expressiveness of the decision support system which is wrapped by the server-side extensions planned. The server-side extensions, in turn, influence the interaction with the users of the system (client-side extensions), for instance the set of connecting factors that a service provider and a service customer are asked to fill as well as the recommendations on jurisdiction/applicable law sent back to them.

Figure 1 shows a high-level overview of existing decision support system components as well as the planned extensions in this Master Project. Starting with the server perspective, the **modeling and implementation of the legal basis** — in terms of modeled and implemented PILs — needs to be enlarged. The current decision support system focuses on the Brussels I regulation only: The regulation has been modeled according to the defined PIL modeling method. The resulting model is available as a UML2 activity diagram. This Brussels I activity diagram has been implemented in Prolog accord-

ing to the respective defined implementation method. The implementation embraces both, Prolog rules (enabling the reasoning about recommended jurisdictions according to Brussels I) and a number of test cases (expressed in Prolog as well, here as Prolog facts). This Master Project foresees in the area of PIL modeling and implementation to follow the defined PIL modeling method and the implementation method. While these two methods shall be taken and applied, this Mater Project's contribution in PIL modeling and implementation is found in a widened geographical scope. This means that PIL coverage shall go considerably beyond the one of Brussels I. At the minimum level, the European PIL perspective shall be completed which implies, for instance, that the Lugano convention and relevant national PILs shall be modeled as activity diagrams and implemented in Prolog (including both, Prolog rules and facts). This part of the Master Project, thus, starts with an investigation and collection of national PILs and bi-/multilateral PIL conventions that need to be modeled and implemented in order to cover electronic service contracts that might have a strong enough connection with a European state to assume that jurisdiction in a European state may be constituted.

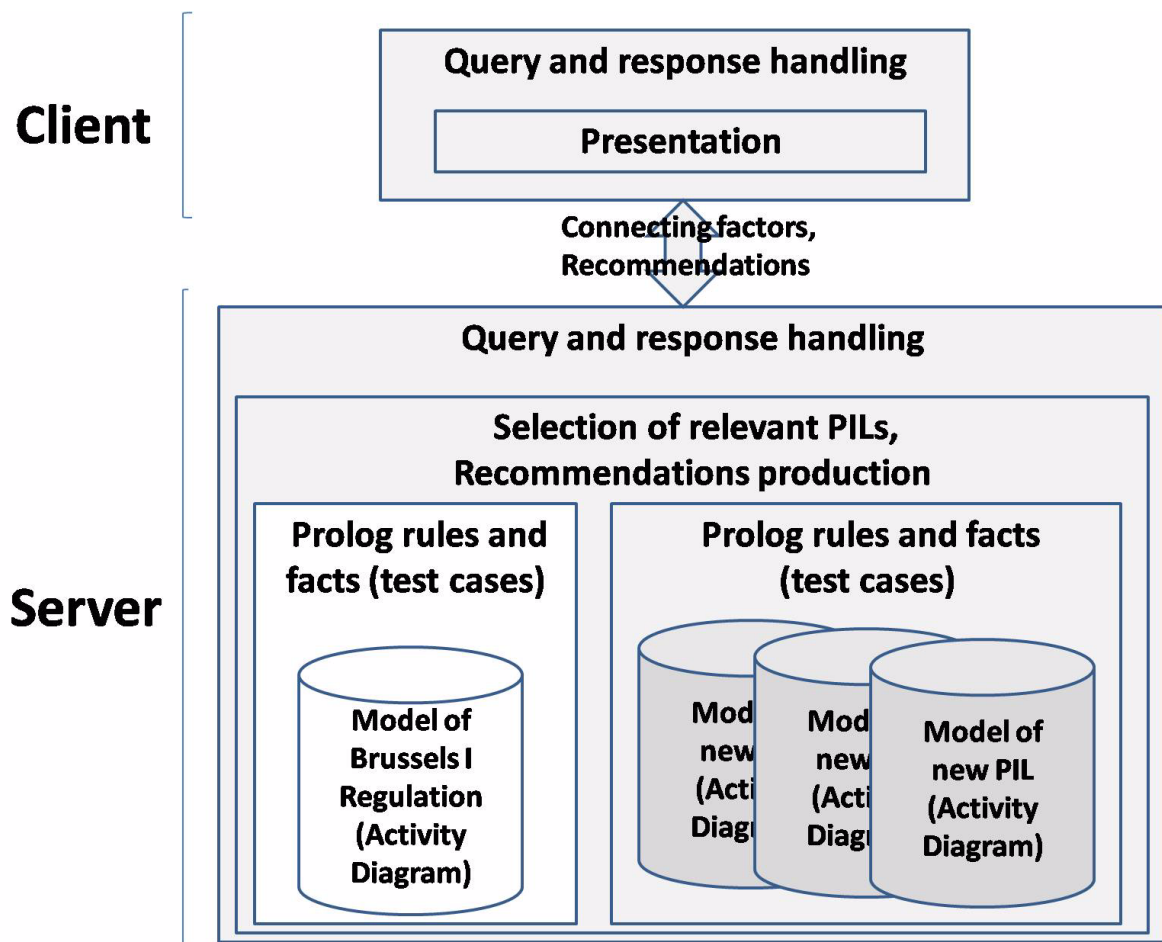


Figure 1: High-level Overview of Existing Components (White Background) and Foreseen Extensions (Grey Background) in the Decision Support System

In addition to the PIL modeling and implementation extensions outlined, the main **server-side extensions** foreseen in this Master Project include multiple functional areas to be worked on. They do not include the actual reasoning about recommended jurisdictions. That part shall remain Prolog-based, but it has to be wrapped by a suited server-side language, such as PHP. This means that the actual Prolog-based reasoning of PIL-specific jurisdiction recommendations is not changed, but it is instantiated by the server implementation on demand by means of a call that instantiates and interfaces with Prolog. The choice in which programming language the sever-side extensions are made is left to the students. It is important, however, that the language shall be free in the sense that no royalty fees for the use of the language or its development tools shall accrue. Moreover, the server-side

extensions shall run in a linux-based environment. In the selection of the server-side programming language, an established, well maintained and tested language shall be given priority.

Besides the described interfacing with the Prolog-based reasoning, work in the server-side extensions of this Master Project covers (a) the server-side handling of queries and answers (interaction with clients), (b) the selection of the relevant PIL-specific recommendation reasoning according to incoming queries, and (c) the collection and transmission of produced jurisdiction recommendations. Questions of interfacing and communications with clients are encapsulated by (a), including, e.g., message sequence and security concerns. In order to make (b) work, an initial suspicion of reasonably connected legal domains (states) has to be determined. For that purpose, the suited though minimal set of initial connecting factors (for a service provider and a service customer) has to be known to the decision support system from (a). The reasoning about such initial suspicion depends on the set of modeled and implemented PILs as each PIL bases on a specific set of connecting factors to be known. Hence, a balance between specifics and a manageable set of initial connecting factors to be submitted by a service customer and a service provider has to be found. Nonetheless, the set of initial connecting factors considered in (b) shall be extensible, *i.e.*, not hard-coded. The implementation of the suspicion reasoning is proposed to be done in Prolog (to be called from the server). Alternatively, it may be implemented in the same programming language as the rest of the server-side extensions. Since (b) will be challenging, (c) may be handled in a more simple way. As mentioned in the introduction, different PILs might result in mutually incompatible jurisdiction recommendations. The server does not need to solve incompatibilities. It is only required to clearly inform service customers and service providers about which PIL recommends what jurisdictions, and where incompatibilities are found.

Finally, this Master Project foresees a **client-side web application** to be designed, implemented, documented, and evaluated as a counter-part of the server-side implementation. As a web application, the client is supposed to be easily accessible in a modern web browser. It shall provide a simple and usable way for both a service provider and a service customer to fill in a minimum set of service- and contract party-specific connecting factors, and to receive recommendations of possibly suited jurisdictions for the contract to be concluded. The client web application's main purpose, thus, is to make the reasoning of the decision support system publicly available in the web so that its functionality may be demonstrated to an interested audience.

From a technological perspective, the client-side web application has to make use of modern web technologies (e.g., HTML5, Javascript) which allow for a high level of usability, a simple albeit fully functional interface (guiding users through the process, supporting them with additional information if needed) with dynamically created content presentation — without the need to install any plug-in or browser add-on. The focus in the client application, thus, shall be on usability with minimum entry barriers. Supportive technologies such as GeoIP, auto-completion, and tool tips shall help users go through all steps of the process smoothly. Equally, the visualization of jurisdiction recommendations at the end of the process shall happen in a way that allows users to grasp relevant information immediately. For instance, this could happen based on a map highlighting recommended jurisdictions.

Beyond this focus on usability and modern web technologies, the client web application depends obviously on a well-working interaction with the server. The client has to respect all communications-driven requirements as defined mainly by the server-side extensions. The client web application, on the other hand, drives the complete workflow so that an early initiated and embracing workflow-oriented functionality and performance testing in several modern web browsers becomes important. Accordingly, server and client are expected to define interfaces and interaction patterns in a very early state of this Master Project, which includes the respective set of test cases to be determined and documented.

3. Master Project Goals

Driven by the description of work outlined, the following determine key goals for this Master Project:

- **Modeling and implementation of legal basis (PIL):** The number of additionally modeled and implemented PILs shall ensure that the European perspective is completed. This means that the decision support system disposes of all relevant PIL models and implementations in order to address electronic service contracts which may be assumed to have a strong enough connection to a European state to constitute jurisdiction in that European state. All newly modeled and implemented PILs shall follow the defined PIL modeling and PIL implementation methods. The resulting UML2 activity diagram models shall satisfy the respective set of formal requirements defined in the PIL modeling method. The resulting implementations shall be Prolog-based as determined by the PIL implementation method, and each implementation's correct functioning shall be documented with the number of relevant test cases and their functional evaluation.
- **Server-side extensions:** The server has to provide a workable interaction with the Prolog-based jurisdiction reasoning. The server shall remain the Prolog-based parts unchanged (these parts shall be wrapped by the server and called/instantiated on demand), while the server itself shall be implemented in a programming language that satisfies the requirements outlined in terms of royalty-free access and run-time environment, on the one hand, and that allows for a scalable interaction with clients, on the other hand. Function-wise, the server-side extensions have to address (a), (b), and (c) fully as described. Especially, the two work items on obtaining an initial suspicion of jurisdictions with assumed connection (b) as well as the communication with clients (a) shall be investigated and solved in detail, while (c) may see a more simple approach. The design and implementation of each work item has to be complete. The documentation has to cover a number of suited and relevant test cases as well as their evaluation.
- **Client-side web application:** The client application shall demonstrate the complete workflow for service providers and service customers in a publicly available, usable and user-supportive manner with minimum entry barriers for interested users. The web application shall make use of modern web technologies that provide users with a smooth and well-guided experience while not requiring the installation of any additional browser plug-in or add-on. The client web application shall run in several modern web browsers. Beyond its focus on usability aspects, the client shall drive the set of workflow-driven test cases that include all steps in client use, server functionality (e.g., initial suspicion of connected jurisdictions), the reasoning of recommendable jurisdictions, and finally the presentation of these recommendations in the client web application.

4. Activities

Based on the description of work, the following tasks targeting the required milestones need to be accomplished:

- Come up with a time and resource planning determining major tasks, detailed activities, and the respective milestones in accordance with this topic description. The time and resource plan shall map milestones and the respective activities onto available human resources in the Master Project (responsibilities), and it shall indicate when a milestone is due. Include in this plan a weekly meeting with your supervisor to discuss progress and potentially needed adaptations to the planning.
- For each of the three main areas of work outlined, determine the appropriate design and document it. Ensure that designs of interacting components are aligned. Start with the definition of the overall workflow (covering all components), then determine external specifications of components (interfaces, message sequences etc.), and define the set of suited test cases (functionality evaluation is a must, performance evaluation good to have) for each step in the workflow. Ensure to have test cases for each component, for component interaction, and for the overall workflow covered.
- Implement your solution according to the design and conduct the respective component-specific, inter-component, and workflow-oriented test cases. Document both the implementation as well as

the evaluation based on conducted tests. Use the CSG test bed for testing and evaluation purposes.

- Deploy the final working solution in the CSG infrastructure so that its client is made publicly available. Produce a distributable software package for server and client. Finalize the documentation.

5. General Notes

- The student has to provide a written schedule for his/her full thesis steps within the first two weeks of his/her work. Clarify details with your supervisor and finalize the schedule of tasks, basically in a weekly fashion. Include the intermediate/public presentation(s), too.
- Prepare an intermediate and internal presentation (20 min max plus Q&A) after half time of your thesis (date to be set) and discuss this with your supervisor. At the thesis' end (date to be set) a final public and self-containing presentation (20 min max plus Q&A) has to be given.
- The final written report will document all work undertaken and remember that this report must be self-contained. Major technical basics are to be included and detailed knowledge obtained during the work must be documented. Assumptions, design decisions, configuration choices, and results are part of the report as well as implementation details and usage information. Correct bibliographic references and a list of papers, recommendations, and descriptions used must be added, including those ones given below.
- Establish periodic meetings with the supervisor to report on progress and to discuss problems.
- Students involved in this thesis are required to read and answer e-mails related to this project at least three times a week. A more frequent, if needed, interaction will determine a better basis for supervision and progress.
- The information sheet on important hints for thesis work is required to be known.

6. Formal Results

Besides the intermediate and final oral presentation of your work the following written documents are part of your work and need to be handed in to the supervisor in time:

- A printed, double-sided report in a soft cover binding and in 3 copies (in English or German): It covers the motivation and introduction, the problem to be solved, the discussion of the design choices, a set of arguments on the final design choice, a list of solved and open issues. A critical consideration of the task, the work, and the result will conclude the report. Additionally, a table of content and figures (including tables), a valid list of bibliographic references, and optional appendices as required is part of the report, too. The official acknowledgement section is mandatory, a personal one optional, however recommended, as usually a number of people took part in the process of finalizing the thesis. The text processing shall be done in FrameMaker (preferred) or LaTeX and in rare cases in Word.
- A documentation of the implemented/configured system, covering the system's view point, an implementation description, a use and installation manual, a documentation of all program and data structures developed or utilized is essential. All of this may be part of the report above, however, in case it will not be included, it must exist in a separate document.
- A dedicated CD for each copy of the report has to be produced: (1) a collection of all program sources, software components, protocol implementations utilized, hardware/product documentation in PDF, related work papers in PDF or full HTML pages, and a directory description; (2) the written thesis (report) in source files, figures in source file and jpg or eps, and a full printable PS as well as PDF file, the set of slides for the final presentation in PowerPoint; and (3) all further material used, if available in electronic form, such as all existing and documented test scenarios, testing plans, and test results.

- A German summary in a maximum of 2 pages (in case of a report written in German, this summary needs to be in English), which will enable a quick and clear survey of this work, tasks and results. This summary will be part of the bound report, and is included after the front page and before any other text will follow. It includes four short sections on: 1. Einleitung/Introduction, 2. Ziele/Aims and Goals, 3. Resultate/Results, and 4. Weitere Arbeiten/Further Work.
- The complete set of copies of the report, the CD, and the talk must be completed and handed in to the supervisor in time before the thesis will change into the "submitted" status. Note that failures of delivering those information and data after the formal hand-in time may result in a "non-passing" state of this work.

7. References

The dissertation of Martin Waldburger (already handed to you in a pre-final version) determines key aspects for this Master Project and it serves as a starting point for the work. Further papers, scenarios, and document research is a must! It is more than highly recommended and may be essential for a successful completion of the work:

Zürich, June 20, 2011

Prof. Dr. Burkhard Stiller